

ARIZONA DEPARTMENT OF ECONOMIC SECURITY

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045Z 05-01-1**A. PURPOSE**

To provide documentation which describes the method used in development of the Housing Unit Method (HUM)

B. AUTHORITY

A.R.S § 41-1954 A14, A15

C. MODEL

The Household Population is composed of all persons living in housing units, as distinct from persons living in group quarters. The household population for any geographic area can be defined in terms of the number of housing units that are occupied and the number of persons per household. This relationship can be presented as an accounting identity:

$$\text{HHPOP} = \text{HU} \times \text{OCCR} \times \text{PPH}$$

Where:

- HHPOP – Persons living in households
- HU – Number of housing units
- OCCR – Proportion of total housing units that are occupied
- PPH – Number of persons per household or average household size

For example the Census 2000 reported that Arizona's population in households was 5,020,782, the state's total number of housing units was 2,189,189 and that 1,901,327 of the housing units were occupied by persons for whom these housing units were their usual place of residence. Housing units may be occupied on a seasonal basis, yet counted by the Census as vacant because the housing units do not serve as a usual place of residence. The ratio of occupied units to total units is the occupancy rate, that is, the proportion of total housing that is occupied. The Census 2000 also reported that the average household size was 2.64 persons. Substituting these values into the formula above illustrates this accounting identity for Arizona.

$$\begin{aligned}\text{HHPOP} &= 5,020,782 \\ \text{HU} &= 2,189,189 \\ \text{OCCR} &= (1,901,327 / 2,189,189) = 0.868507 = 86.9\% \\ \text{PPH} &= (5,020,782 / 1,901,327) = 2.640673 = 2.64\end{aligned}$$

$$\begin{aligned}\text{HHPOP} &= \text{HU} \times \text{OCCR} \times \text{PPH} \\ 5,020,782 &= 2,189,189 \times 86.9\% \times 2.64\end{aligned}$$

In order to estimate population of an area—be it the state, a county or municipal jurisdiction—what is needed are estimates of the number of housing units, the occupancy rate, and average household size. Ideally, current estimates of the three factors are used such that household population for a specific year may be estimated as follows:

$$\text{HHPOP}_{2005} = \text{HU}_{2005} \times \text{OCCR}_{2005} \times \text{PPH}_{2005}$$

In practice it is possible to estimate changes to the number of housing units by relying on administrative records such as certificates of occupancy, demolition permits and mobile home placements. However there is generally a lack of objective and reliable data on occupancy rates and average household sizes in the years following a decennial census. In some cases sample surveys have been produced that yield reasonable estimates, but in general these are only available for areas with very large populations. In the absence of updated estimates of occupancy rates and average household size, one procedure is to hold these constant at their value in the last census. In this case, the estimates formula for 2005 becomes:

$$HHPOP_{2005} = HU_{2005} \times OCCR_{2000} \times PPH_{2000}$$

D. INPUT DATA

Housing Units

The estimates of housing units are prepared annually and build on the previous year's estimate. The starting point for a decade is the counts provided in the decennial census. The decennial census count of housing units is broken down by four types: 1-unit in structure (e.g. - single family homes and townhouses); 2-4 units in structure (e.g. – duplexes); 5 or more units (apartment building), and mobile homes. Through the use of administrative records, municipal jurisdictions report to the Arizona Department of Economic Security changes in the housing stock by quarter. Additions to the housing stock by type are summarized from certificates of occupancy. Additions for mobile homes are based on mobile home permits. Subtractions from the housing stock are based on demolition permits. Changes in municipal boundaries require changes to the census base and the number of affected housing units is reported.

Occupancy Rates

The occupancy rate is the proportion of total housing units that are occupied, consistent with the Census Bureau's residency rules on "usual place of residence." The rates for all jurisdictions are derived from the Census 2000, Summary File 1, Table H3 - Occupancy Status. The table reports total, occupied and vacant housing units. The occupancy rate is calculated as follows:

$$\text{Occupancy Rate} = \text{Occupied Units} / \text{Total Units}$$

Data for the State of Arizona serve to illustrate:

$$\text{Occupancy Rate} = (1,901,327 / 2,189,189) = 0.868507 = 86.9\%$$

Persons Per Household Size

Persons per household, also referred to as average household size, is a statistical average calculated by dividing the number of persons living in households by the number of households (which is the same as occupied housing units). The Census Bureau reports persons per household for all jurisdictions in Census 2000, Summary File 1, Table P17 - Average Household Size. The data are derived by dividing values in Table P16 - Population in Households by Table P15 – Households.

$$\text{Persons Per Household} = (5,020,782 / 1,901,327) = 2.640673 = 2.64$$

E. ADJUSTMENTS

The place controlled population is calculated using the following formula:

$$CONPOP = (HUMPOP * WEIGHTEDAVG) / SUMHUMPOP$$

Where:

CONPOP = Controlled Population

HUMPOP = Population calculated using the Occupied households times Persons Per Household plus the number of people living in Group Quarters

WEIGHTEDAVG = The county population calculated using a weighted average of the Housing Unit Method and the Composite Method

SUMHUMPOP = The sum of individual place HUMPOP in each county

F. EVALUATION

Errors for population estimates are evaluated in census years by calculating the difference between the value of the estimate and the official census count. The difference is error. Expressing the difference as a percent and then calculating the mean percent error for all counties or places yields a summary measure of the bias in the estimates. A negative value means the populations, on average, were underestimated; and a positive value means that the estimates tended to be high. The closer the average is to a value of zero, the less bias in the estimates. This measure of bias is called the Mean Algebraic Percent Error, or MALPE for short. Another way to express bias in estimates is to calculate the percent of positive differences that is, what proportion of the estimates were high. Here a value close to 50% means there is little bias—that is a tendency to over or under estimate.

A second group of summary measures of error are intended to assess the precision of the estimates. If the estimates are in error by substantial differences yet the errors are equally balanced as positive and negative the MALPE and % Positive Differences will show low or no bias. In order to summarize the precision of the estimates, that is how far they vary from the census count, Mean Absolute Percent Error, referred to in shorthand fashion as MAPE, is used. By calculating the absolute error and determining the mean value across all counties or places, the precision of the estimates may be determined. The closer to zero the lower the variation in estimates from the census count and the better the precision of the estimates. A closely related summary measure of precision is to count the proportion of estimates that have relatively large errors in percentage terms. A commonly used set of thresholds is errors greater than 5 and 10 percent.